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#### Description

Method for data exchange between a computer tomograph and an injector, and apparatus having a computer tomograph and an injector

The invention relates to a method for data exchange between a computer tomograph and an injector according to the preamble of claim 1, and to an apparatus, comprising at least two devices, according to the preamble of claim 10.

When a patient is being examined by means of computed tomography, he/she is injected with a contrast agent via an injection system, denoted as injector below for short. The contrast agent serves the purpose of more effective visualization of the organ to be examined, which is transilluminated by X-rays in the computer tomograph. Images with the aid of which a doctor can undertake a diagnosis are generated via an imaging system from the X-ray signals acquired by a detector.

Both the X-radiation of the computer tomograph and the contrast agent injected via the injector impose a burden on the patient to be examined. Both the burden owing to X-radiation and the burden owing to the contrast agent must therefore be kept as light as possible. Consequently, it is normally only the mandatory quantity of contrast agent that is injected. It is decisive here for the quality of imaging via the computer tomograph that the scanning operation of the computer tomograph be carried out at the correct instant. The correct instant is reached as a rule when the organ to be examined has been reached as desired by the injected contrast agent. In order to impose as little burden as possible on the patient, the radiation dose should be as light as possible, in addition. DE 195 33 557 C1 discloses a method in which a suitable instant

for the start of the scanning operation can be determined in a comparatively gentle way.

The level of the burden on the patient, and the quality of the images obtained are decisively codetermined also by the operating staff, who must operate the two devices, the computer tomograph, on the one hand and the injector, on the other hand, in a suitable way. Particularly in the case of the occurrence of malfunctions at one of the two devices, the experience and the reaction of the operating staff sometimes exerts considerable influence on the burden on the patient owing to the radiation or the contrast agent.

US 2001/0009994 A1 discloses an injector provided in particular for the application of a contrast agent. The injector can be connected via a data interface to an imaging system, in particular a computer tomograph, in order to enable data exchange between two devices or automated driving of the injector and/or the imaging system.

Likewise disclosed in the English language patent abstract JP 01207038 A is a computer tomograph that is connected via a data interface to an injector provided for the application of a contrast agent. Here, the injector is driven automatically by a control device of the computer tomograph.

Further arrangements in the case of which a data exchange is performed between a computer tomograph and an injector are disclosed, for example, in US 2002/0165445 A1 or US 2002/0071521 A1.

The invention is based on the object of enabling improved operation of a computer tomograph and an injector.

The object is achieved in accordance with the invention by means of a method in accordance with claim 1.

Consequently, the two devices communicate with one another via the data interface such that their respective operation, that is to say the carrying out of the scanning operation, on the one hand, and the injection of the contrast agent, on the other hand, can be suitably coordinated overall with one another. The two devices can be coordinated with one another, particularly with regard to the starting operation of the examination and given the occurrence of a malfunction, by the exchange of current operationally relevant data. Furthermore, the linking of the two devices via the data interface offers the possibility to coordinate the two devices more effectively with one another even during the investigation, and to transmit the data obtained during the investigation from one device to the other device in an automatic fashion, for example for a patient-specific evaluation.

By coordinating the devices, it is possible, in particular, to reduce maloperations and to achieve an improved use of the devices with regard to the lightest possible burden on the patient.

A mutual control of the devices on the occurrence of a malfunction of one of the devices is performed in the course of the examination, that is to say of the scanning operation by the computer tomograph, on the one hand, and the injection by the injector, on the other hand. This malfunction is transmitted to the other device and displayed there, for example, such that, in particular, manual intervention by the operating staff is also enabled. Consequently, by transmitting and displaying the malfunction of the injector, for example, through a display element of the computer tomograph the operating staff need only keep an eye on the display element of

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the computer tomograph in order to be able to detect a malfunction at an early stage and to react suitably. Conversely, of course, the operating state of the

computer tomograph can also be displayed on a display element of the injector. Particularly in the case of failure or termination of the scanning operation and/or of the injection, it is possible thereby for the entire examination to be terminated manually at an early stage in order to keep the burden on the patient light.

In the presence of the malfunction a decision is made preferably automatically with the aid of a termination rule as to whether the operation of the other device is terminated or continued. It can be provided thereby, on the one hand, that a termination signal that prompts the operating staff to terminate manually is output acoustically, for example. With this variant, the final decision on the termination of the examination remains with the doctor or operating staff. That is to say, merely automatically in order to support the operating staff it is therefore merely automatically determined whether the termination would be expedient in accordance with the termination rules. As an alternative to this, the examination is, moreover, expediently terminated automatically and independently without the possibility of exerting influence.

Furthermore, the two devices mutually exchange data relating to their respective operating state. The data connection between the two devices is therefore bidirectional such that mutual monitoring is also possible, in particular.

In accordance with a preferred development, the data transmitted by one device is used as a basis to control the operation of the other device. One device therefore directly influences the other device. Necessary control measures at one device, caused by a specific operating state of the other device, are therefore undertaken automatically without need for manual intervention by the operating staff.

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It is expedient here to provide at the beginning of the examination that before starting to operate one device the operational readiness of the other device is checked.

If one of the devices is not operationally ready, the start of the operation of the other device is preferably automatically suppressed. The automatic suppression can consist here in a delay until the other device is operationally ready, or in a complete termination such that both devices have to be restarted once more. Thus, for example, it is automatically investigated upon starting the computer tomograph whether the injector is operationally ready. Conversely, it is checked upon starting the injector as to whether the computer tomograph is operationally ready for carrying out the scanning operation. Unnecessary burdens on the patient owing to contrast agent and/or to X-radiation are avoided by means of these starting operations that are coordinated with one another.

Given the presence of a malfunction, decision parameters are preferably provided for taking a decision as to whether termination should be performed. The values for these decision parameters are determined here, in particular, from one or more of the following criteria, and used for the termination rule:

- Values are automatically adopted from the operating data of at least one of the devices. Thus, for example, the quantity of the contrast agent already injected is an important criterion.
- It is expedient also to take account of manually input values for the termination rule. Thus, it can be expedient for the doctor to specify up to which quantity of contrast agent, referred to the total quantity to be prescribed, a termination is to be performed. This manually prescribed value is then used to terminate the examination automatically upon undershooting of the value.
- Organ-specific termination criteria are preferably also taken into account, that is to say different termination responses are advantageous for different organs.

The device parameters of one device are respectively read out by the other device and evaluated.

For the purpose of a simplified evaluation of the examination results, an expedient development provides that a scanning-specific or injection-specific data protocol is transmitted from one device to the other device after the scanning operation or the injection has been carried out. Thus, for example, the computer tomograph inputs into its memory the data protocolled or stored during the injection by the injector, and there is advantageously set up a common data protocol that combines with one another the values of the computer tomograph and those of the injector, in particular via a common time axis.

The invention is further achieved by means of an apparatus having the features in accordance with claim 10. The advantages and preferred refinements set forth with regard to the method are to be transferred to the apparatus mutatis mutandis.

An exemplary embodiment of the invention is explained in more detail with the aid of the figure. The sole figure shows a computer tomograph and an injector in a schematic, greatly simplified block diagram illustration.

A computer tomograph 2 and an injector 4 have comparable functional components in the exemplary embodiment. The comparable functional components of the computer tomograph 2 are marked in the figure with the letter A, and those of the injector 4 are marked with the letter B.

The two devices respectively have a computer device 6A, B to which a display element 8A, B and an input element 10A, B are connected. Control signals are transmitted to the computer device 6A, B via the input element 10A, B, for example a



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keyboard, switch or the like. The display element 8A, B and the input element 10A, B are prefer

Patent claims

1. A method for data exchange between a computer tomograph (2) and an injector (4), in the case of which the two devices (2, 4) mutually exchange data relating to their respective operating states via a data interface (20A B), and a malfunction, occurring during operation, of one device (2, 4) is transmitted to the other device (4, 2), characterized in that in the presence of the malfunction a decision is made automatically with the aid of a termination rule as to whether the operation of the other device (4, 2) is expedient.
2. The method as claimed in claim 1, in which the data transmitted by one device (2, 4) is used as a basis to control the operation of the other device (4, 2).
3. The method as claimed in one of the preceding claims, in which before starting to operate one device (2, 4) the operational readiness of the other device (4, 2) is checked.
4. The method as claimed in claim 3, in which the start of the operation of one device (2, 4) is automatically suppressed if the other device (4, 2) is not operationally ready.
5. The method as claimed in one of the preceding claims, in which decision parameters are provided for the termination rule, values for the decision parameters
  - being adopted automatically from the operational data of at least one of the devices (2, 4) such as, for example, the quantity of the already injected contrast agent, and/or
  - being input manually before the start of the operation, and/or
  - being determined in an organ-specific fashion taking account of an organ to be examined, and/or

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- being determined in a patient-specific fashion and input,  
and/or

- being determined with the aid of the protocol characterizing the carrying out of the scanning operation and/or the injection.

6. The method as claimed in one of the preceding claims, in which current operational data of one device (2, 4) are displayed on a display element (8B, A) at the other device (4, 2).

7. The method as claimed in one of the preceding claims, in which one of the devices (2) is provided with a common operating console (12A) with the aid of which it is also possible to drive the other device (4).

8. The method as claimed in one of the preceding claims, in which the data interface (20A, B) is standardized for the data exchange between the devices (2, 4).

9. The method as claimed in one of the preceding claims, in which after the carrying out of the scanning operation and/or the injection, a specific data protocol of one device (2, 4) is transmitted to the other device (4, 2).

10. An apparatus having a computer tomograph (2) and an injector (4), in the case of which the computer tomograph (2) and the injector (4) are designed via a data interface (20A, B) for mutually exchanging data relating to their operating state to the respective other device (2, 4), and a malfunction, occurring during the operation, of one device (2, 4), is transmitted to the other device (4, 2), characterized in that the devices (2, 4) are further designed in such a way that in the presence of the malfunction a decision is made automatically with the aid of a termination rule as to whether the further operation of the other device (4, 2) is expedient.

Abstract

Method for data exchange between a computer tomograph and an injector, and apparatus having a computer tomograph and an injector

In the case of the apparatus and of the method provided for a computer tomograph (2) and an injector (4) wherein an injection of a contrast agent is controlled via the injector (4) and a scanning operation is controlled via the computer tomograph, it is provided that operationally relevant data are transmitted, in particular mutually, between the computer tomograph (2) and the injector (4) via a data interface (20A, B). In particular, the two devices (2, 4) alternately exert influence on their operation. As a result, the burden imposed on a patient to be examined is kept light, the operational reliability is increased and the operation is simplified.

FIGURE 1